Restricted Circulation

This paper is not an official document; it is for information only and must not be quoted in any printed publication.

Agricultural Memorandum No. 608

On the weather risk with autumn sown leys

C V Smith

1. The alternative to undersown cereals (where grasses can at times cause combining difficulties), is the autumn sown ley. Such leys are not invariably successful in the Eastern Region and some statement on the risk of failure has been called for.

   Failure here is taken to mean not simply the physical absence of plants, but includes failure in the economic sense, such as would be indicated by an unacceptable plant density or stage of development before the onset of winter temperatures. In other words, though one could envisage that a satisfactory ground cover might eventually be established, if this were estimated to be at the expense of a seed crop in the coming season (assuming a seed crop was the target), then nevertheless, at the level of establishment shown, the crop would be considered a failure.

2. As in Agricultural Memorandum No 584 (On the establishment of catch forage crops), the probability of a satisfactory establishment has been examined on the assumption that rainfall and soil moisture deficits can provide guide lines and criteria for success.

   The observation that soil temperatures at 10 cms depth commonly begin to fall below 6°C in the second week of November in the Eastern Region has been used to suggest a limit to significant plant growth after this time.

   The awareness that cereal crops may effectively cease transpiring around mid July has been used to indicate the earliest date at which soil moisture budgeting should begin.

   The previous crop, and seed bed preparation for the ley have been taken to dry the soil in the topmost layers. An initial soil moisture deficit of 25 mm on July 15th has been assumed in those topsoil layers, which at field capacity would hold 25 mm available water.

   The problem has been seen as falling into 2 phases, the first associated with seedling germination and emergence, the second with seedling establishment.

   There would appear to be no precise and detailed information available on the soil moisture requirements in the phases outlined. This fact alone has been taken to outweigh any breakdown of the problem into the different characteristics and requirements of individual grass species, or of mixed leys or of the annual trend of radiation and temperature over the period for study. (Given that soil moisture is non-limiting, this last consideration

should presumably be reflected in different time requirements for the phases at different parts of the season). Accordingly drawing on broad husbandry experience the simple generalisation has been made that we may throughout consider soil moisture status over 2 successive 14 day periods, the first being relevant to germination and emergence, the second to seedling establishment (root extension).

In contrast to the catch forage crop problem where an early start to growth was seen as essential, it has been assumed here that long periods of seed dormancy could be accepted (if, for example, rainfall was long delayed after sowing into a dry soil).

3. Instead of setting out purely arbitrary soil moisture criteria for success, it has been possible to make use of the knowledge of a significant crop failure in the Beccles area of Essex in 1972, and the contrasting successes in the years 1971 and 1973.

For each of these years, between July 15 and November 10, a daily soil moisture balance was struck. The layers of soil considered were those top 5 layers (numbered 1 to 5 downwards from the surface) that would at field capacity, each hold 5 mm available water. Soil moisture inputs were provided by the daily rainfall data of Earls Colne. Soil moisture losses were assumed at the average daily potential transpiration rate, these values being obtained by curve fitting to the mean monthly value (as given in MAFF Technical Bulletin No. 16).

It was assumed that for dormancy to be broken (and germination initiated), 3 successive days were required, on each of which there was some soil moisture in soil layer 1.

The criteria for success suggested by the data were

<u>Germination phase</u> (14 days in total)

If the germination phase is to be counted successful then in the 11 days immediately following germination initiation,

no more than 4 consecutive days
and/or no more than 7 days in total

are permitted on which there is no soil moisture in soil layer 1.

<u>Establishment phase</u> (14 days in total)

No establishment phase is considered without an immediately preceding successful germination phase.

If the establishment phase is to be considered successful, then in the 14 days immediately following a successful germination phase,

no more than 7 consecutive days
and/or no more than 9 days in total

are permitted on which there is no soil moisture in layers 1 and 2 (ie those topmost soil layers, which together would hold 10 mm available water at field capacity).

The data suggest that soil moisture below layers 1 and 2 is not in fact available to the plants at the stage of growth we consider; a further suggestion thrown up by the data is that in the situation where the layers 1 and 2 are dry and there is moisture below the rate of soil drying runs ahead of the vertical root extension.

4. The results of applying these criteria to the longer period Cambridge data (years 1951-1973) are shown in Figure 1.

A cut-off point is taken at October 10, since in general, germination initiated after this time will not allow a full 14 day establishment period in which soil temperatures do not become restrictive.

The diagram shows the occasions when seed in the ground would probably have been successfully established. It does not necessarily imply strong plant growth over the whole period since since included, in a great many instances, are long spells of dry weather during which the seed would have remained dormant. Losses of seed in such dry spells have been discounted.

The diagram indicates that seed in the ground in July and the first half of August is at an unacceptable risk due to germination initiation which is not subsequently sustained by adequate rainfall. In the past 10 years, seed placed any time in August would have been more likely to fail than not.

Seed after this time, from September through to mid October would appear to have about a 60% chance of success.

5. If the view is taken that agricultural meteorology is not simply about associations between weather and farm and field data, but that it finds a pay-off only when used to influence decisions, then we must look beyond the immediate statistics and probabilities shown here to inquire how they can best contribute to farming strategies.

Faced at the beginning of September with the decision whether to go for a ley or not, the only weather prediction likely to be of use is the monthly forecast of rainfall.

If a forecast of average rainfall or above is taken to imply successful crop establishment (and conversely, a forecast of rainfall below average is taken to imply a crop failure), then over the sample of years examined, we find the results shown in Table 1.

Table 1.

September Forecast	Actual Crop Results: Successful establishment	Actual Crop Results: Failure
Monthly rainfall - average or above	8	1
Monthly rainfall below average	6	8

If the decision to sow an autumn ley is made only when the expected September rainfall is average or above, then the long term expectation of crop failure (40% of occasions) is reduced to about 10% of occasions (1 in 9).

The decision not to plant when the rainfall is below average avoids the losses that occur on about 50% of such occasions (8 in 14).

There are missed opportunities for a successful ley on the remaining 50% of such occasions, but in early September there are a wide variety of other options still open. The cost of such missed opportunities may in fact be purely nominal.

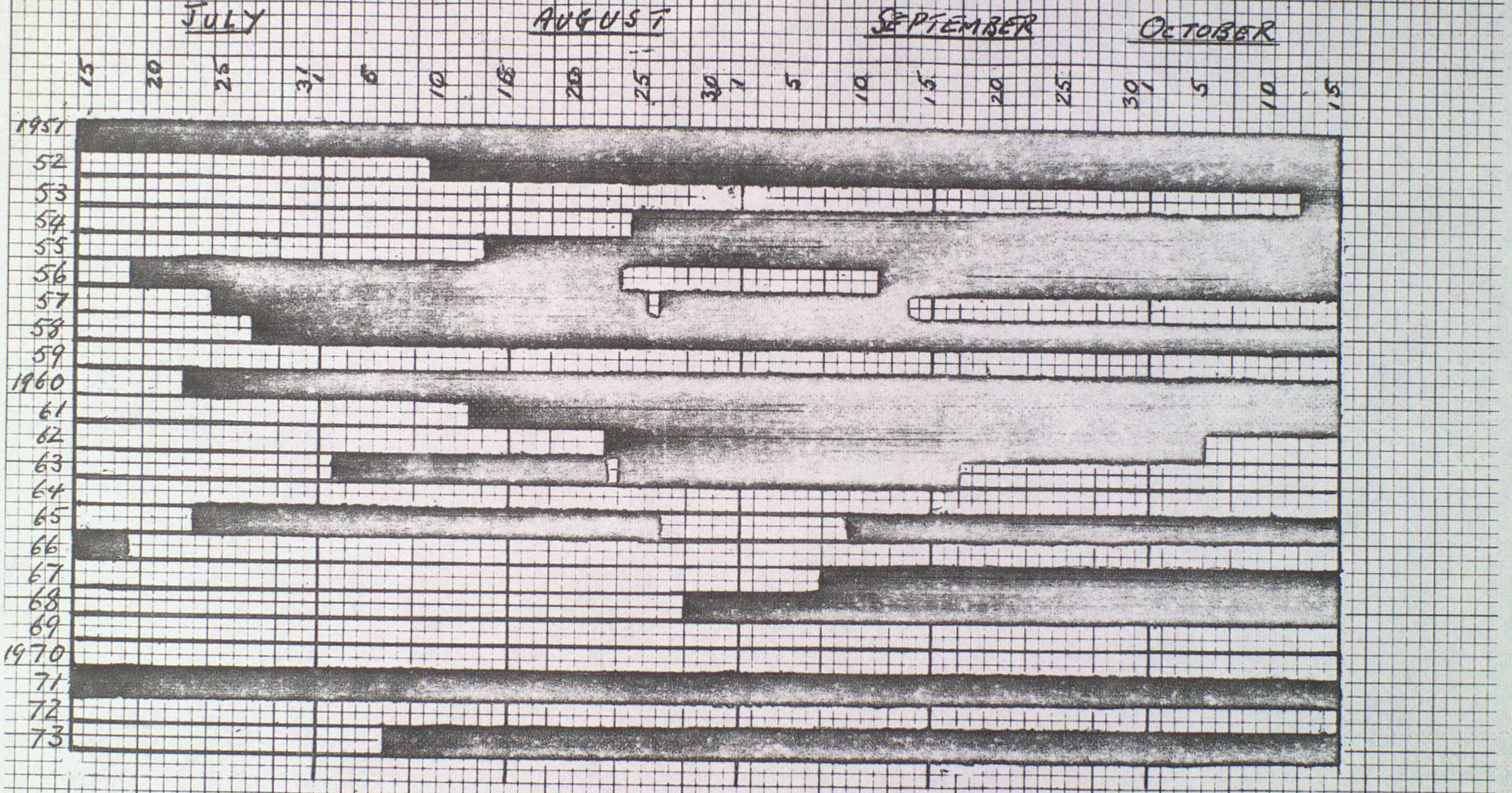
Acknowledgement

It is necessary to thank Mr Howard Mead, ADAS Agronomy, for useful discussions.

Meteorological Office
Cambridge.

February 1974

FIGURE 1



INDICATES OCCASIONS WHEN SEED IN THE GROUND AT THIS TIME WOULD HAVE BEEN SUCCESSFULLY ESTABLISHED.